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AN ARITHMETICAL TEST IN THREE PHILADELPHIA HIGH SCHOOLS.

By Jonathan T. Rorer.

Introductory.

It has often been stated that the modern high school pupil does not possess ordinary skill in the common arithmetical processes. He has met unfavorable criticism in this respect not only from the college professor, who reports him unable to perform correctly the easy numerical work of the laboratory, but also from the man of business who frequently claims that the high school boy who finds his way into commercial life, cannot even add, subtract, multiply and divide.

As an experiment to test the truth of the latter criticism, the following questions, without previous warning, were simultaneously put to twelve hundred students in three of the large Philadelphia high schools, to one hundred students in each of the four years of the course in each of the three schools.

The Question Paper.

Philadelphia, Nov. 17, 1910.

Read these Directions Carefully.

1. Solve each problem in space provided, directly underneath.

Note: The question sheet was 9 × 14 inches, and the questions were properly spaced.

2. Place all work on this sheet and indicate result clearly.

3. Write name and grade at top of reverse side of sheet.

1. Add the following:

34256
78242
52167
785862
1946
71234
8761
326504
361
651302

2. A man who has saved $142.96 still has $72.01 less than his brother has; how much have they together?

3. A has 35¾ yards of cloth; B has 5½ yards more than A; and C has 12¼ yards less than B. How many yards have they all?

4. How much do I gain if I buy 300 oranges at the rate of $1.25 per hundred, and sell at 25 cents a dozen?

5. From a farm of 800 acres I sell 10 per cent. to Mr. Johnson, and 20 per cent. of the remainder to Mr. Fleming. How much do I still own?
6. Multiply .052 by 108.04. Divide the product by 200. (Result to three decimal places.)
7. Find the interest of $800 for 9 yrs. 5 mos. at 6 per cent.

It is evident that the above questions are in no sense a test of high school work, nor even of the advanced, or more difficult arithmetic of the elementary grades, but it is believed that they cover fairly well the more common computations of business. If the accusation of the business man is correct that our school product cannot perform the fundamental operations with proper facility, this test should surely show it. It was not claimed that it would show much more. The results, however, do seem to show some additional points of interest. While the test was timed to one half hour, it was found that less than five per cent. of the pupils used more than 20 miutes.

Results of the Test.

The questions were each given the same credit in the marking, and each was marked either right or wrong, no partial credits being given under any circumstances. Each paper was then given an average in the usual way. The average of the individual averages was then obtained for each of the three schools, and for each of the classes (first, second, third and fourth year) in each of the schools. The percentage of correctness for each of the seven questions was also computed. These facts are shown below:

Average of the schools: School A, 85.6 per cent.
School B, 83.7 per cent.
School C, 74.5 per cent.

Averages by Classes in the Schools.

School.	First Year.	Second Year.	Third Year.	Fourth Year.
A (boys)	83.1	74.7	86.4	95.1
B (girls)	73.8	82.6	91.2	89.4
C (girls)	68.0	74.1	80.0	79.0

Percentage of Correctness in Answers.

Number of question	1	2	3	4	5	6	7
Percentage correct	90	91	86.3	89.5	86.9	69	87.3

Discussion of the Results.

The above figures show that the students tested were, at any rate, not disgraced. Some would maintain that the questions were so easy that no credit is due high school pupils for obtaining the above grades. If the business man's criticism is not answered, the above testimony is at least favorable to the schools.

The influence on these results of the course of study in mathematics in the several schools is of interest.

In school A, the boys tested were almost exclusively in the classical and scientific courses, their mathematics being algebra, geometry, algebra continued, and trigonometry. But two commercial course sections were tested, sixty students. These were fourth-year boys who had been drilled in commercial arithmetic during their second year, but whose training in algebra and geometry was less than half that of the classical and scientific students. It is noteworthy that these commercial students averaged slightly less than the classical and scientific students in the same school year.

In school B, the first-year girls study algebra, while the second-, third- and fourth-year girls, being in the commercial course, study arithmetic.

In school C, the girls tested study algebra and geometry during the first three years and arithmetic in the fourth year.

The minimum ability of the boys for such work during the second year was not unexpected. Many teachers have noted this to be a time in the boy's high school career when accuracy is attained with great difficulty. After this period, his improvement is continuous, and the maximum of 95.1 per cent. in the fourth year, may be considered quite satisfactory.

An unexpected maximum of the girls' ability would seem to be in the third year. In school B, the girls of the fourth year who had received two hours per week instruction in arithmetic for one year more did not do so well; while in school C, it would seem that the girls are more accurate in such elementary calculation before receiving high school instruction in arithmetic than they are after receiving it. However, the decrement of the fourth year in the girls' schools is so slight that it may be assigned to accidental causes and it would therefore be unwise to draw any definite conclusion from it.

The important lesson to be learned from the percentages of correctness is that teachers should give more emphasis to decimals. The percentage of error in question 6, was more than twice that of any other question. The average of correctness, considering all questions, was 84.3 per cent. It will be noted that on all questions save the sixth, the percentage of correctness is fairly uniform. If the sixth question be omitted, the average of correctness would be 88.5 per cent.

CONCLUSIONS.

Considering the character of this test, it is believed we can draw these conclusions from the above figures when studied with reference to the mathematical training of the pupils involved.

1. The high school boys or girls do not forget the fundamental arithmetical operations and the criticism that they cannot do simple commercial calculations with reasonable accuracy and speed is unwarranted.

2. The study of high school mathematics, not exclusively arithmetic—algebra, geometry, trigonometry, does not interfere with facility in simple commercial calculation but, on the other hand, increases the ability of the students in accuracy and speed.

3. The formal study of arithmetic in the high school is not necessary that pupils may retain the elementary school training in the simple business calculations.

My thanks are due to Mr. Albert H. Raub, District Superintendent of Schools, who prepared the questions, and arranged the test in the three schools, and who has kindly placed the above at my disposal for discussion.

WILLIAM PENN HIGH SCHOOL,
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